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The Adoption of Computerized Crime Mapping by Municipal Police Departments in New Jersey

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A mail survey of 347 municipal police departments in New Jersey was conducted to determine the number of departments currently doing computerized crime mapping, as well as how long they had used the innovation and, if they were not currently mapping, whether they had plans to start in the future. The overall rate of adoption, as of the end of 2002, was 13.8 per cent. Department size was strongly associated with mapping use—agencies with 100 or more sworn full-time officers were six times more likely to have adopted crime mapping than agencies with fewer than ten officers. Despite this finding, there was no evidence of hierarchical diffusion. Large departments had not typically adopted the innovation earlier than had small departments. The article concludes with a discussion of the barriers facing crime mapping adoption by small departments.

Key Words: Crime mapping; diffusion; innovation; police; New Jersey

Introduction

The mechanisms underlying the spread (or 'diffusion') of crime prevention innovations are similar to those governing the spread of other innovations. There must be a few intrepid early adopters, and they must communicate with those who might potentially adopt the innovation. These two elements have been observed in scores of studies, most notably in a community of doctors with the adoption of a new type of antibiotic,[2] among Iowan farmers with the adoption of hybrid seed corn,[3] and in rural Sweden with the adoptions of a variety of agricultural and technological advances.[4] The diffusion of innovations approach has been used in criminal justice to examine the spread of DARE,[5] 9-1-1,[6] in-house computer systems in urban American police departments,[7] police uniforms and technologies,[8] police batons,[9] community policing,[10] and computerized crime mapping.

The extent of computerized crime mapping use by police departments was examined by the International Association of Chiefs of Police in the mid-1990s. In a survey of 280 members of the Law Enforcement Management Information Section, 30 per cent of the departments claimed to have used mapping software. Members of this section tended to use technologies more than typical departments, so this percentage of crime mapping users was higher than would be the case for the general population of police departments.[11] In 1997 and 1998, the Crime Mapping Research Center (CMRC) at the National Institute of Justice conducted a nationally-representative mail survey of over 2000 police departments, asking about use of crime mapping software. Overall, the rate of use was 13 per cent (15.5 per cent for municipal departments), yet there was much variation between types of departments. Large departments, ie those with 100 or more sworn officers, were 12 times more likely to use computerized crime mapping than small departments (36 per cent vs. three per cent).[12]

The CMRC data were further analyzed by Weisburd and Lum, who examined the temporal diffusion of crime mapping by graphing responses to the question: 'For how long has the department been doing crime mapping?' They found that in the earliest years of computerized crime mapping, few departments had adopted the technology, but over time the number of new adopters grew, and more rapidly with every year.[13] This pattern was the initial stage of the 'S-curve' that has been observed repeatedly in other diffusion research. In 2001 Weisburd and Lum subsequently conducted their own pilot study of agencies with 100 or more sworn officers in order to focus on the relationship between research and crime mapping innovation. They found that the steep slope on the S-curve distribution still held, even four years later.[14]

Based on these studies, we know that computerized crime mapping has spread among police departments in a pattern typical of the diffusion of other innovations. However, the studies primarily focused on large departments, so less is known about crime mapping diffusion among small departments. This is a serious oversight, because these agencies comprise the majority of policing organizations in the United States. If crime mapping is considered a worthwhile tool for small departments, it is useful for those interested in diffusing the technology (such as the Department of Justice[15]) to know whether it is likely to be adopted by those departments.

The present study

This study explores the diffusion of a particular crime prevention innovation—computerized crime mapping—among municipal police departments in the state of New Jersey. Specifically, it seeks to describe how crime mapping spread throughout the state over time, and to determine what demographic factors (particularly department size) explain adoption or non-adoption. Also, it examines whether patterns typically noted in other diffusion studies with respect to differences between early and later adopters are observable in this population and with this particular innovation.

Method

A self-administered questionnaire was designed which asked questions about the current status of mapping use, intentions to adopt crime mapping, and, if applicable, when the department first began using crime mapping technology.[16] Following a pretest and a pilot study, the New Jersey Crime Mapping and Communication Survey was mailed in November 2002 to the chiefs of all 484 municipal police departments in New Jersey.[17]

The response rate was 72 per cent; after the second mailing of the survey, 347 departments had responded. These departments were generally similar to the entire population. Response rates were much lower than average for departments serving populations between 1001 and 5000, of which only 56 per cent replied. However, there was no statistically significant difference between responders and non-responders with respect to either the number of sworn officers or the number of civilian employees. Responding departments were somewhat more likely to serve larger populations than were non-responders, but this was not significant at a 0.05 level. Comparing the entire population to the responding group with respect to the 'character' of the jurisdiction revealed a significant lack of adequate representation from what are classified as 'rural centers'. This underrepresentation is probably indicative of a low level of crime mapping usage in this sort of jurisdiction, and a corresponding lack of interest in completing and returning the questionnaire.

Results

The extent of crime mapping use

Slightly more than ten per cent of the departments in the survey (n = 36) indicated they were currently using computerized crime mapping. Twelve departments said they had used it in the past, but had since stopped doing so. This means that although 48 departments (or 13.8 per cent of the sample) had adopted the crime mapping innovation at some point, only three-quarters of those continued to use it. However, it is not unusual for adopters to abandon an innovation after they start using it; this is known as 'discontinuance', and despite its importance to understanding and predicting diffusion patterns, the phenomenon has barely been studied by researchers. Unfortunately, the small number of discontinuers identified in this study did not allow for extensive analysis.

Of the departments that had never adopted crime mapping, 30 per cent indicated they planned to do so in the future, and of this group, two-thirds expected to adopt the innovation within one year.

Factors related to crime mapping use

Department size (as measured by the number of sworn full-time officers)[18] was by far the most significant variable explaining crime mapping adoption. Larger departments were significantly more likely ($p < 0.001$, Eta = 0.282) to have adopted mapping than were smaller departments. Agencies with 100 or more sworn personnel were close to six times more likely to be using the innovation compared to those with fewer than ten sworn personnel, and more than twice as likely compared to departments with 50 to 99. On average, adopting departments had 116 sworn officers, while non-adopting departments had 35 ($t = 2.43$, $p < 0.05$). Other variables, such as population served, number of civilian employees, and crime rate (both violent and non-violent), also explain crime mapping adoption. These latter variables, however, are strongly correlated with department size, and when department size is introduced as a control variable, the relationships between the variables and mapping adoption disappear.

Mapping adopters are disproportionately located in urban centers[19] (see Table 1). Over half of the responding police departments serving urban centers had adopted crime mapping, compared with fewer than one in eight of those departments in other types of jurisdictions. Urban center departments comprise a mere 6.2 per cent of municipal police agencies in the state, yet they represent 23 per cent of crime mapping adopters.

Table 1. Crime mapping adoption by jurisdiction type, municipal police departments, New Jersey, 2002–2003

Jurisdiction type[a]	% of departments[b] (n = 338)	% of adopters (n = 48)	% adopting crime mapping
Rural	11.5	8.3	10.3
Rural center	5.3	0.0	0.0
Suburban	51.5	41.7	11.5
Urban suburb	25.4	27.1	15.1
Urban center	6.2	23.0	52.4
Total	**99.9[c]**	**100.1[c]**	**14.2**

$\chi^2 = 29.71$, df = 4, $p < 0.001$; Cramer's V = 0.296

[a] This variable was taken from the 2001 Uniform Crime Report *Crime in New Jersey.*

[b] Jurisdiction type was not available for all 347 survey respondents.

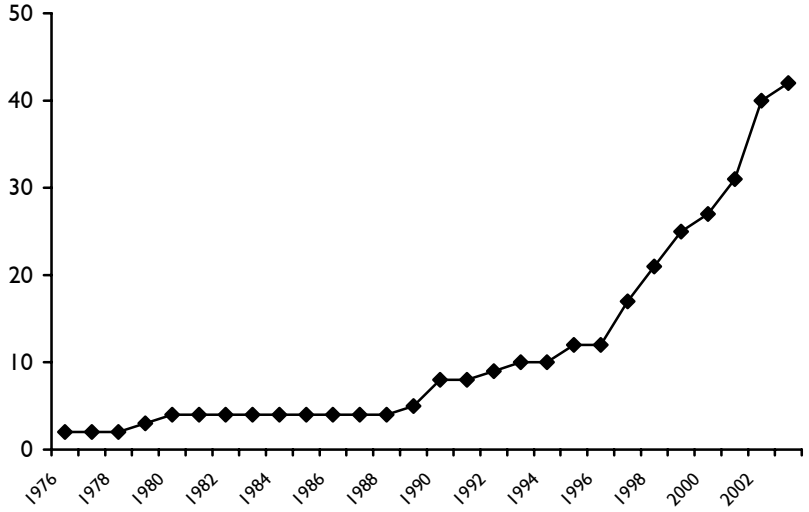
[c] Total does not equal 100.0 due to rounding.

Source*: New Jersey Crime Mapping and Communication Survey, 2002–2003*

Patterns of crime mapping diffusion

The manner in which crime mapping adoption spread throughout the state mirrors the start of the S-curve previously noted in a national sample of police departments.[20] Figure 1 shows that although a few departments in New Jersey reported having adopted computerized crime mapping in the 1970s and 1980s, growth in the number of new mapping adopters was flat until the early 1990s. At that time, there was a small increase in the cumulative number of adopters, but the fastest increase happened only after 1996.

Figure 1. Cumulative number of new crime mapping adopters, by year of adoption, municipal police departments, New Jersey, 1976–2003*



* Of the 48 departments that indicated they had adopted computerized crime mapping, six did not give the year of adoption.

Source: *New Jersey Crime Mapping and Communication Survey, 2002–2003*

Is there a difference between the earliest crime mapping adopters and those who adopted it later? In a particular model of diffusion, known as 'hierarchical' diffusion, an innovation spreads over time from large population centers to progressively smaller ones, or from opinion leaders to connected but less-influential people, then to the relatively disconnected and non-influential members of a population. There is an assumption of some sort of status difference between early adopters and later adopters.

In the case of crime mapping among police departments in New Jersey, if hierarchal diffusion is at work this could be manifested by early adoption by large departments, followed by the spread of the innovation to successively smaller agencies. For the purposes of examining this more closely, size of department was operationalized as the number of sworn officers; as was previously noted, this variable was highly correlated with the other measures of size, specifically population served and number of civilian employees. Table 2 is a contingency table comparing departments that adopted crime mapping before 1999 and those that adopted it later, in terms of department size. If hierarchical diffusion had occurred, one would expect to see a larger proportion of bigger departments as early adopters (before 1999) than would be noted for smaller departments. However, this is not the case, and indeed, the pattern is the opposite of what would be expected. This is not statistically significant; the chi-square test indicates no meaningful association between time of adoption and department size. The outcome was the same for a comparison of means for the department size variable; the resulting t-statistic was insignificant ($p = 0.438$).

Table 2. Period of crime mapping adoption, by number of sworn officers, municipal police departments, New Jersey

Number of sworn officers[a]	Adoption year before 1999	1999 or later	Totals
Under 10	2	0	2
10–25	6	3	9
26–49	3	5	8
50–99	5	6	11
100 or more	5	7	12
Totals	**21**	**21**	**42[b]**

$\chi^2 = 3.924$, $df = 4$, ns

[a] This variable was taken from the 2001 Uniform Crime Report *Crime in New Jersey.*

[b] Of the 48 departments that indicated they had adopted computerized crime mapping, six did not give the year of adoption.

Source: *New Jersey Crime Mapping and Communication Survey, 2002–2003*

Discussion

Consistent with the literature on innovation diffusion,[21] department size was significantly associated with crime mapping adoption. Size is strongly related to an organization's ability to prudently take risks. Larger police departments are likely to have a greater ability to absorb losses associated with adopting innovations that do not ultimately work out. The cost of implementing crime mapping is a small part of a large department's budget; although adopting the innovation may not be more expensive for small departments, the portion of total resources used is considerably higher. Furthermore, large departments may already have computers and staff that can be devoted to implementing crime mapping technology. They may have more people available who can apply for grants to purchase the computer software and hardware needed for crime mapping. Externally, large departments tend to serve urban jurisdictions with both a higher incidence of crime and higher crime rates, so the objective need for crime mapping is more likely to exist. There may also be pressure on large departments to maintain technological superiority over or equality with similarly-sized departments.[22]

There was no evidence of hierarchical diffusion. Larger municipal police departments in New Jersey were not more likely than smaller departments to adopt mapping early on in the diffusion process. This seems contrary to the observation of higher rates of adoption among larger agencies. But this contradiction can be explained by considering the diffusion process among agencies of all sizes, and the time frame for this process. When New Jersey departments with over 100 sworn officers are considered, their rate of crime mapping adoption was 44.4 per cent, which compares favorably with Mamalian and La Vigne's figure from 1997–98 of 36 per cent for similarly-sized agencies,[23] and Weisburd and Lum's figure of 65 per cent.[24] Based on their findings, and making assumptions from the diffusion rate for comparable innovations, Weisburd and Lum estimated that the diffusion process for crime mapping was between one-half and two-thirds of the way along.[25] Likewise, Harries argued that the crime mapping adoption process would be rapid.[26] These predictions were largely derived from observations of the diffusion of mapping among large police agencies; the rate of diffusion among smaller departments was ignored.

Assuming that a pattern of hierarchical diffusion should exist requires accepting the premise that the process of crime mapping diffusion is fairly far along. Only if the process is nearly complete does it make sense to classify adopters into different time periods of adoption and then to examine their characteristics in order to investigate the possibility of hierarchical diffusion. Classifying adopters as early, or late, or laggards is problematic if the innovation has not saturated the population.[27]

Whether it is best to conduct diffusion studies after the innovation period is complete is debatable. If one wishes to find evidence of hierarchical diffusion, it is obviously preferable to wait until all potential users have adopted. But conducting a survey of potential users midway through the diffusion process provides a more valid 'snap-shot' of one moment in time than would be possible to obtain years later. Memories, both human and organizational, degrade over time. The present research did not allow for a genuine examination of hierarchical diffusion, yet it nonetheless provides a useful benchmark for crime mapping diffusion studies of this population in the future.

What then, can be made of the apparent contradiction between higher rates of adoption by large departments, but no evidence at this point of hierarchical diffusion? If the diffusion process is still in its early stages (when large agencies have adopted at higher rates than other agencies, even though many smaller departments have adopted as well), as the process continues the number of new adoptions by large agencies will start to level off as the innovation reaches saturation point in this subset of the population. If smaller agencies continue to adopt crime mapping, their numbers will begin to overtake those of larger departments. A hierarchical pattern of diffusion could well be evident in a study of the spread of crime mapping among municipal police departments in New Jersey conducted several years from now.

Barriers to crime mapping adoption by small departments

Small departments are much less likely than their larger peers to have adopted computerized crime mapping. Why this is the case is unknown, as this study did not specifically ask why a department did not begin using the innovation, although some respondents provided written comments that give some insights. In addition, Travis and Hughes recently commented on the obstacles to crime mapping adoption, and although they did not focus exclusively on small departments, their remarks certainly apply to this subset of police agencies.[28]

It is likely that the technological demands of the innovation dissuade small police departments from adopting it. The technical expertise required to implement computerized crime mapping may be onerous to some agencies. While the innovation makes it considerably easier to construct crime maps than it was in the past, it is not in fact as simple as it first appears. Considerable instruction in the software is needed to construct even basic pin maps. Small departments tend not to have the resources to pay or the manpower to spare someone for this training. Similarly, a lack of resources can make it difficult for small departments to buy the software and equipment needed for crime mapping.

Geo-coded data may not be practically available for small agencies, many of whom are not yet fully using computer-aided dispatch systems.[29] One department, interested in using crime mapping to facilitate a car break-in prevention scheme at a shopping mall parking lot, ended up hiring a university professor who was able to put their calls-for-service data into a useable format.

How to help small departments

Assuming that widespread adoption of crime mapping by municipal police departments of all sizes in New Jersey is a worthwhile goal, several things can be done to address the barriers to adoption experienced by smaller agencies. If lack of technical expertise is a significant impediment

to mapping adoption by small departments, provision of feasible crime mapping training at local universities and community colleges could support these needs. This might work practically in New Jersey, a small state with a good network of community colleges and distance learning venues. This form of educational outreach would be less effective in larger, less densely-populated states, where travel time to and from training sites could be excessive.

Small departments might be more willing to adopt crime mapping if the usefulness of the innovation is demonstrated to them. One small agency along the Jersey Shore has experimented with some success in regularly creating maps for patrol shifts. If line officers can be convinced of the value of an innovation to them, institutionalization of the innovation is greatly enhanced.[30] As an example, when video cameras were first placed in patrol cars, they were met with much resistance from line officers, who resented the cameras as another means of managerial control. Over time, however, the value of the cameras as a tool to minimize problems associated with citizen complaints became apparent, and officers supported the innovation they had once so vigorously opposed.

Financing a crime mapping system seemed to be a big problem, testified to by several police chiefs who were interested in adopting the innovation, but could not afford it. If inexpensive systems do exist, it could be the case that police departments do not know about them, or are hesitant to approach vendors for more details. An appropriate role for government would be to collect and assess information from vendors, and then distribute it, free of technical jargon, to departments across the state.

Another approach to facilitate crime mapping outside large urban areas is multi-jurisdictional mapping systems. Many of the chiefs surveyed commented that criminals do not recognize borders, and that crime patterns in their areas are regional. They advocated the establishment of cooperative county- or state-wide crime mapping. La Vigne and Wartell describe successful ventures along these lines in Baltimore, in Orange County, California, in San Diego County, in Virginia, and in Delaware.[31] The advantages of multi-jurisdictional approaches are many—cost-sharing, improved expertise, shared expertise, and enhanced analytical capabilities. But there are also difficulties, mostly related to sharing data and to incompatibility of data and information systems.[32]

Despite the barriers faced by police departments considering adopting computerized crime mapping, most of the police chiefs were interested in the innovation, and were eager for more information on the topic. However, the preponderance of very small departments in New Jersey, along with fiscal constraints on those departments and little realistic need for the technology, means computerized crime mapping will probably never reach saturation levels among this population of potential adopters.

Conclusion

The main findings of this study provide some support to the innovation diffusion literature. The conclusion that department size is strongly associated with adoption of computerized crime mapping was not unexpected. Yet the absence of hierarchical diffusion was surprising. Whether this is because crime mapping may still be in the early stages of the diffusion process in New Jersey will only be known after a follow-up study of the same population in several years' time.

The study adds to the previous research examining the diffusion of computerized crime mapping among police departments in the United States.[33] Yet those studies are limited because they predominantly focused on departments with more than 100 sworn officers, and used data derived from nationally representative samples. The present study adds to this literature by sampling

departments with fewer than 100 sworn officers in addition to larger departments. The study's focus on one state, as opposed to the entire country, resulted in a more complete picture of the diffusion process in a limited geographical area.

The findings from this research may not be generalizable. First, the study focused only on police departments in New Jersey, which has a strong tradition of 'home rule', which essentially means each of the state's more than 500 separate municipalities exercises individual decision-making and budgetary authority over all local governmental affairs—including the provision of policing services. The diffusion of crime mapping in places with more regionalization of local governments and policing might be very different. Second, the research studied only municipal police departments, so its findings should only cautiously be applied to other types of agencies. Third, computerized crime mapping was the only innovation considered in the study. Other innovations certainly diffuse in different ways and over different time spans.

The present study should be replicated in other regions of the country. A study in California, which has a high rate of mapping adoption compared to New Jersey, would provide an opportunity to test whether mapping is likely to achieve saturation levels among small police departments. It would also be instructive to conduct diffusion studies of different crime prevention innovations to see if the patterns observed in the present study can be generalized beyond computerized crime mapping.

Notes

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2 Coleman, J., Katz, E. and Menzel, H. (1957) The Diffusion of an Innovation among Physicians. *Sociometry*. Vol. 20, No. 4, pp 253–70. See also Menzel, H. and Katz, E. (1955) Social Relations and Innovation in the Medical Profession: The Epidemiology of a New Drug. *Public Opinion Quarterly*. Vol. 19, No. 4, pp 337–52.

3 Ryan, B. and Gross, N.C. (1943) The Diffusion of Hybrid Seed Corn in Two Iowa Communities. *Rural Sociology*. Vol. 8, No. 1, pp 273–85.

4 Hägerstrand, T. (1967) *Innovation Diffusion as a Spatial Process*. Trans. Pred, A. Chicago, IL: University of Chicago Press. Originally published in 1953 as *Innovationsförloppet ur Korologisk Synpunktin*. Lund: C.W.K. Gleerup. For an extensive review of the voluminous innovation diffusion literature, see Rogers, E.M. (1995) *Diffusion of Innovations*. 4th edn. New York: Free Press.

5 Rogers, E.M. (1993) Diffusion and Re-invention of Project D.A.R.E. In Backer, T.E. and Rogers, E.M. (eds) *Organizational Aspects of Health Communication Campaigns: What Works?* Newbury Park, CA: Sage.

6 Seaskate, Inc (1998) *The Evolution and Development of Police Technology*. Washington, DC: Seaskate, Inc; Skolnick, J.H. and Bayley, D.H. (1986) *The New Blue Line: Police Innovation in Six American Cities*. New York: Free Press; Sparrow, M.K., Moore, M.H. and Kennedy, D.M. (1990) *Beyond 911: A New Era For Policing*. New York: Basic Books.

7 Mullen, K.L. (1996) *The Computerization of Law Enforcement: A Diffusion of Innovation Study*. PhD dissertation, School of Criminal Justice, State University of New York, Albany. Ann Arbor, MI: UMI.

8 Monkkonen, E.H. (1992) History of Urban Police. In Tonry, M. and Morris, N. (eds) *Modern Policing, Crime and Justice: A Review of Research*. Vol. 15. Chicago, IL: University of Chicago Press.

9 Peak, K. and Hubach, J.D. (1993) The World's Oldest Tool for Professional Law Enforcement: Historical and Legal Perspectives on the Police Baton. *Justice Professional*. Vol. 7, No. 2, pp 1–22.

10 Oliver, W.M. (2002) The Third Generation of Community Policing: Moving through Innovation, Diffusion, and Institutionalization. *Police Quarterly*. Vol. 3, No. 4, pp 367–88.

11 Rich, T.F. (1995) *The Use of Computerized Mapping in Crime Control and Prevention Programs*. Research in Action. Washington, DC: National Institute of Justice.

12 Mamalian, C.A. and La Vigne, N.G. (1999) *The Use of Computerized Crime Mapping by Law Enforcement: Survey Results*. Research Preview. Washington, DC: National Institute of Justice.

13 Weisburd, D. and Lum, C. (2001) *Translating Research into Practice: Reflections on the Diffusion of Crime Mapping Innovation*. Keynote address delivered at the Fifth Annual International Crime Mapping Research Conference, 1st–4th December, Dallas, TX.

14 Ibid.

15 Task Force on Crime Mapping and Data-Driven Management (1999) *Mapping Out Crime: Providing 21st Century Tools for Safe Communities*. Washington, DC: US Department of Justice.

16 The design of the questionnaire was influenced by Alexander Weiss's work on informal communication between police departments (see Weiss, A. (1998) *Informal Information Sharing Among Police Agencies*. Research Preview. Washington, DC: National Institute of Justice), as well as by the instrument used in the National Institute of Justice Crime Mapping Survey.

17 The names of the police chiefs and the mailing addresses were obtained from the 2002 New Jersey Law Enforcement Resource Directory (published annually by the New Jersey State Association of Chiefs of Police), and where addresses were missing from this source, from a commercial website at *http://www.usacops.com*. Some addresses could only be located by searching for the police department on the World Wide Web using a search engine such as *http://www.google.com*.

18 Demographic data on all municipal police departments in New Jersey from the 2001 Uniform Crime Report, *Crime in New Jersey*, were incorporated into the dataset.

19 Thirty jurisdictions in New Jersey are categorized as 'urban centers': Asbury Park, Atlantic City, Bound Brook, Bridgeton, Camden, Cape May, Dover, Dover Township, East Orange, Elizabeth, Englewood City, Flemington, Hackensack, Jersey City, Long Branch, Millville, Morristown, New Brunswick, Newark, Passaic, Paterson, Perth Amboy, Plainfield, Red Bank, Somerville, Trenton, Union City, Vineland, Wildwood, and Woodbury.

20 Weisburd and Lum, op cit.

21 Rogers (1995) op cit.; Damanpour, F. (1992) Organizational Size and Innovation. *Organization Studies*. Vol. 13, No. 3, pp 375–402.

22 Abrahamson, E. (1991) Managerial Fads and Fashions: The Diffusion and Rejection of Innovations. *Academy of Management Review*. Vol. 16, No. 3, pp 586–612.

23 Mamalian and La Vigne, op cit.

24 Weisburd and Lum, op cit.

25 Ibid.

26 Harries, K. (1999) *Mapping Crime: Principle and Practice*. Washington, DC: Crime Mapping Research Center, National Institute of Justice.

27 Rogers (1995) op cit, p 263.

28 Travis, L.F. and Hughes, K.D. (2002) Mapping in Police Agencies: Beyond This Point There Be Monsters. *Overcoming the Barriers: Crime Mapping in the 21st Century*. No. 2, August. Washington, DC: Police Foundation.

29 Ibid.

30 Ibid.

31 La Vigne, N.G. and Wartell, J. (2001) *Mapping Across Boundaries: Regional Crime Analysis*. Washington, DC: Police Executive Research Forum.

32 Ibid.

33 Weisburd and Lum, op cit.; Mamalian and La Vigne, op cit.